

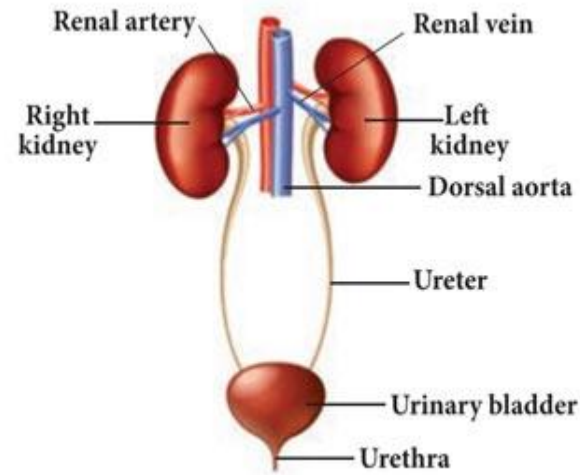
## Excretion:

The process of removal of chemical wastes (mainly nitrogenous wastes) from the body is known as 'excretion'.

Excretion plays an important role in maintaining the homeostatic (steady state) condition of the body.

## Excretory System:

Organs which are concerned with the formation, storage and elimination of urine constitute the 'excretory system'.



## Substances to be eliminated:

### 1. Carbon dioxide and water

- Carbon dioxide is eliminated through the lungs.
- The extra water is released out of the body. in the form of sweat.

### 2. Nitrogenous Wastes

- These include urea, uric acid and ammonia.
- Urea is excreted out through the kidneys.

**3. Excess salts** such common salt (NaCl) and even some excess water-soluble vitamins (B and C) need to be eliminated.

- Salts are mainly given out through the kidneys.

**4. Water** is taken in with food and beverages, in large quantities.

**5. Bile pigments** (chiefly yellow bilirubin) are the breakdown products of the hemoglobin of the dead RBCs.

- Excreted in urine.

## The Excretory Organs:

**1. Kidneys:** These are the primary excretory organs eliminating nitrogenous wastes in the form of urine.

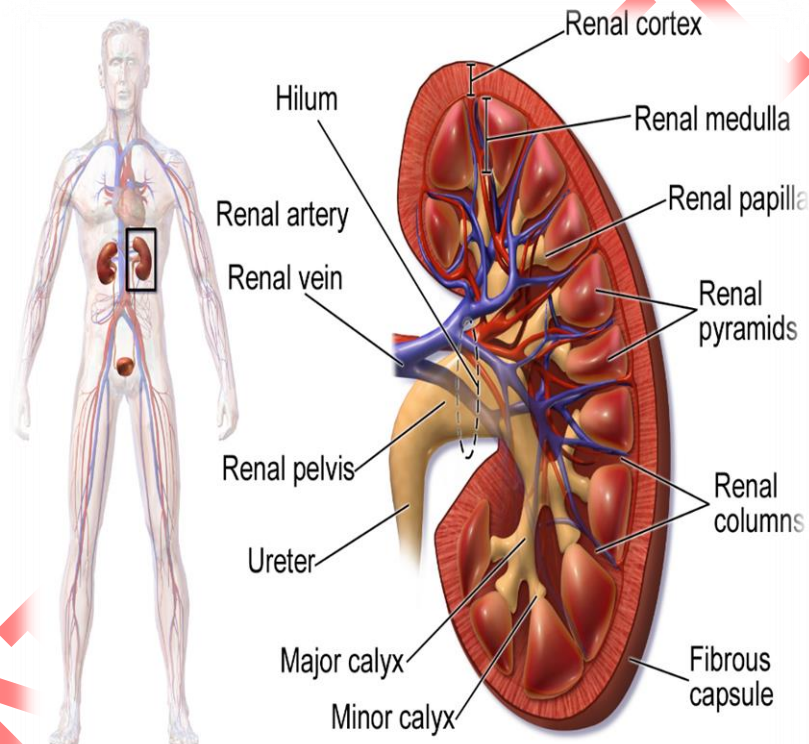
**2. Skin:** Sweat excreted by the sweat glands of the skin primarily excrete water and sodium chloride.

**3. Lungs:** They excrete carbon dioxide.

**4. Liver:** Liver detoxifies ammonia by converting it to urea.

## Kidneys

The kidneys are two bean-shaped organs located on either side of the backbone and protected by the last two ribs. A tube, the ureter, arises from the notch (hilum) connects behind with the urinary bladder. The front end of the ureter is somewhat expanded into the kidney and is called the pelvis. The urine produced in the kidneys collects in the urinary bladder to the outside of the body through the urethra. A sphincter (circular muscle) guards the opening of the bladder into the urethra and relaxes only at the time of urination (micturition) under an impulse from the brain.



Kidney Anatomy

## Internal Structure of the Kidneys

A longitudinal section of the kidney shows two main regions—an outer dark cortex and an inner lighter medulla. The medulla is composed of a finely striped substance arranged in several conical pyramids. The apex of each pyramid is called **papilla**. The kidney is composed of an enormous number of minute tubules called uriniferous tubules or nephrons. These are the structural as well as functional units of the kidney.

## Structure of a Kidney Tubule

Bowman's capsule is a thin-walled cup. The outer concavity of the cup lodges a knot-like mass of blood capillaries, called glomerulus.

**Proximal or first convoluted tubule (PCT)** is the starting convoluted region of the tubule. Middle U-shaped part (**Loop of Henle**) is shaped like a hair-pin.

**Distal convoluted tubule (DCT)** is the end part of the kidney tubule. It opens into a collecting duct.

### Blood supply to the Kidney

**Tubules:** Each such arteriole enters a Bowman's capsule under the name of afferent arteriole. This afferent arteriole breaks into a number of capillaries. The reuniting capillaries of the glomerulus form the efferent arteriole.

### Functions of the Kidney -

#### Production of Urine:

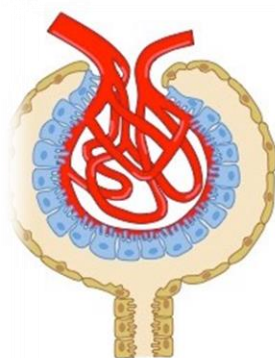
The production of urine occurs in three major steps:

- (I) ultrafiltration
- (II) reabsorption
- (III) tubular secretion

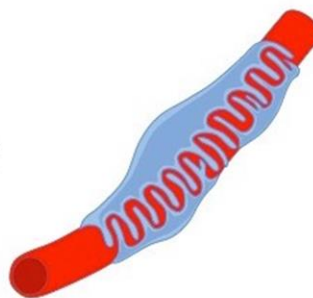
(I)

#### Ultrafiltration

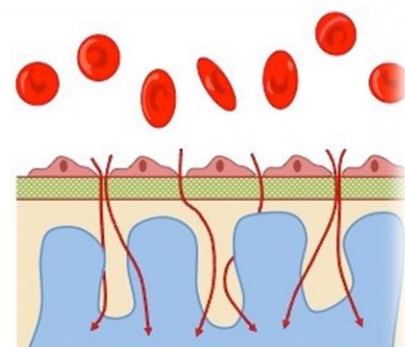
The blood flows through the glomerulus under great pressure which is much



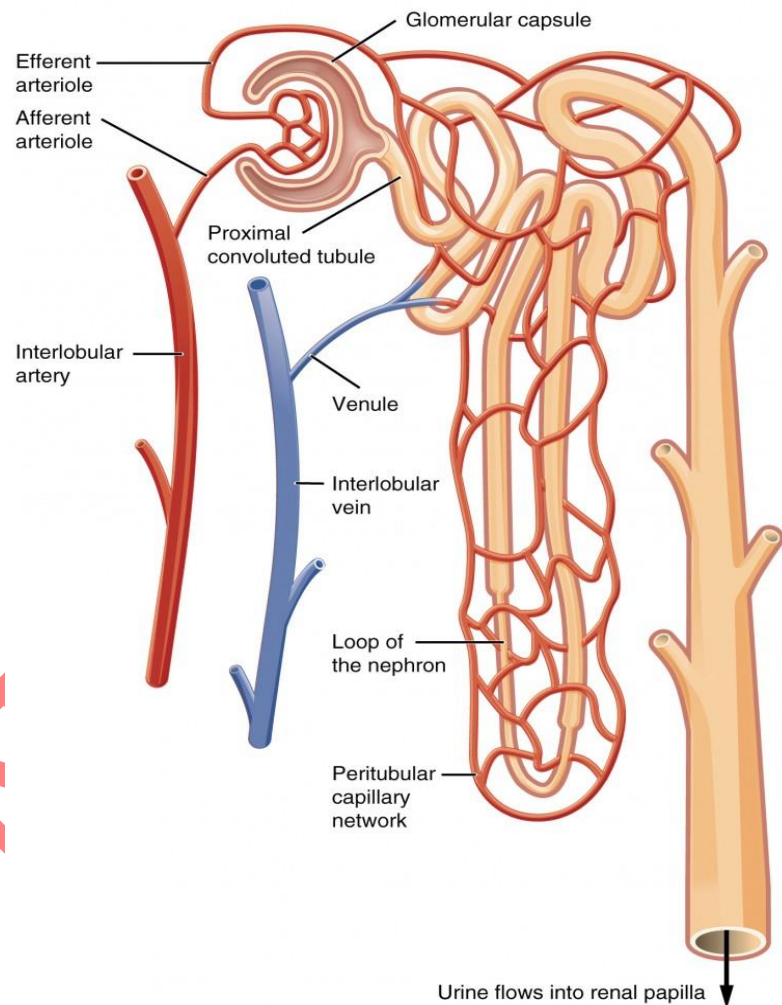
Glomerulus + Bowman's Capsule



Podocytes



Basement Membrane

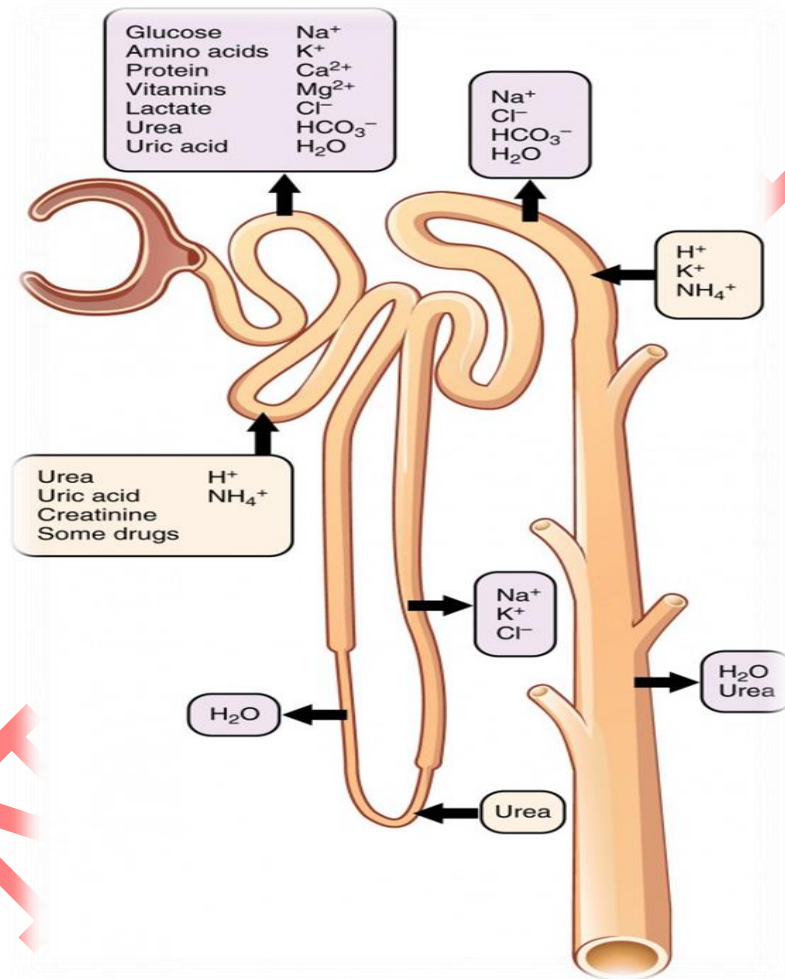




greater than in the capillaries elsewhere. This filtration under extraordinary force is called ultrafiltration. The fluid entering the renal tubule is called the glomerular filtrate. The glomerular filtrate consists of water, urea, salts, glucose and other plasma solutes.

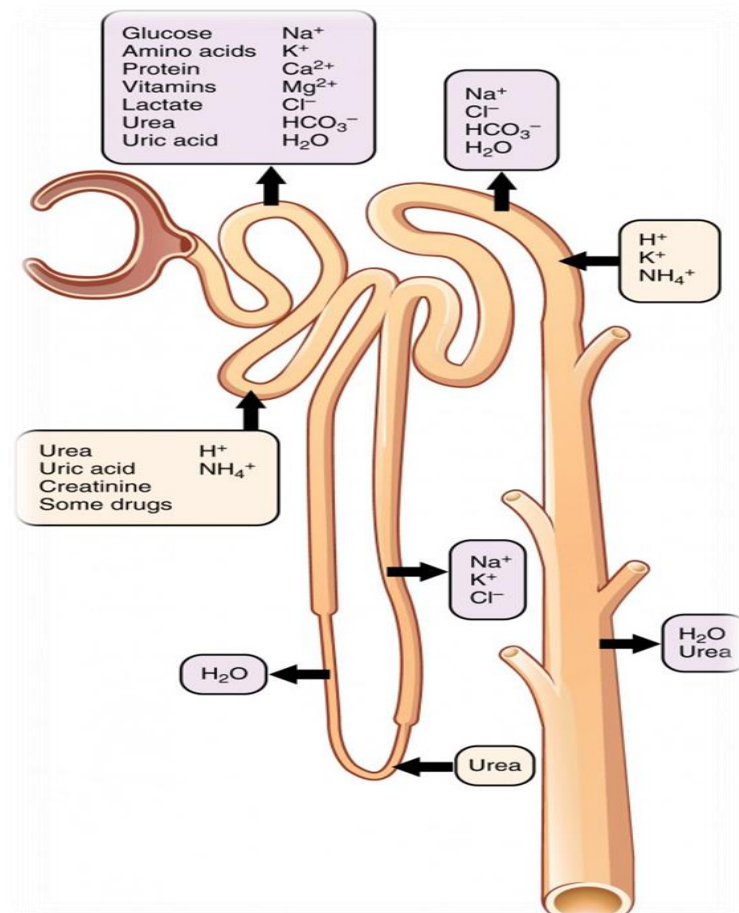
## (II) Reabsorption:

The glomerular filtrate entering the renal tubule is not urine. It is an extremely dilute solution containing a lot of useful materials including glucose and some salts such as those of sodium. The normal concentration of the blood is not disturbed. This is called selective absorption.



## (III) Tubular Secretion:

Certain substances like potassium ( $\text{K}^+$ ) and a large number of foreign chemicals are passed into the forming urine. This passage involves the activity of the cells of the tubular wall, and hence it is called tubular secretion.



### **Physical properties of urine-**

- Colour: Clear yellow (due to pigment urochrome).
- Volume: 1 to 1.5 litres per day but varies.
- pH: 5 to 8
- Odour: ammonia-like
- Specific gravity: 1.003 to 1.035

### **CONSTITUENTS OF URINE**

The normal human urine consists of about 95% of water and 5% of solid wastes dissolved in it.

Abnormal constituents in urine

- (i) Blood cells: Known as haematuria
- (ii) Glucose In a condition called glycosuria.
- (iii) Albumin: This condition is termed as albuminuria.
- (iv) Bile pigments: Due to anaemia, hepatitis (jaundice) or liver cirrhosis, urine may contain bile pigments.

### **REGULATION OF URINE OUTPUT**

The pituitary gland and Diuresis (increased production of urine) - Concentration of the urine by water reabsorption is controlled by antidiuretic hormone (ADH) secreted by the posterior lobe of the pituitary gland.

### **OSMOREGULATION**

The kidney while removing wastes like urea from the blood also regulates its composition, i.e., the percentage of water and salts. This function is called osmoregulation it implies the regulation of osmotic pressure of the blood.

## ARTIFICIAL KIDNEY:

If one kidney is damaged or removed for some reason, the other kidney alone is sufficient for excretory needs and the person can lead a normal life. Artificial kidney is a dialysis machine.

